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Review Article

Diversity of *Ocimum* (Lamiaceae) species in India and their significance

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Abstract: The genus *Ocimum* (Tulsi), belonging to the family Lamiaceae, represents one of the most culturally, medicinally, and economically significant plant groups in India. The country harbours considerable diversity of *Ocimum* species, including *O. tenuiflorum*, *O. basilicum*, *O. gratissimum*, *O. kilimandscharicum*, *O. americanum*, *O. filamentosum*, and the hybrid *O.* × *africanum*. These species exhibit wide variation in morphology, essential oil composition, and ecological distribution, reflecting their adaptability across Indian agroclimatic zones. Traditionally, Tulsi has played a vital role in Ayurveda and indigenous healing systems, where different species are used to treat bronchitis, fever, gastrointestinal disorders, malaria, diarrhoea, and kidney ailments. Modern pharmacological studies further validate their antimicrobial, anti-inflammatory, antioxidant, and metabolic regulatory properties, underscoring their potential in herbal medicine and nutraceutical development. Despite their therapeutic relevance, habitat loss, overharvesting, and limited germplasm documentation pose threats to genetic diversity. This review synthesizes current knowledge on the diversity, distribution, ethnomedicinal relevance, and pharmacological potential of *Ocimum* species in India, emphasizing the need for conservation and further molecular and phytochemical research.

Keywords: Adaptogenic properties, essential oils, ethnomedicine, phytochemical variability, therapeutic applications

Introduction

The genus *Ocimum* L., belonging to the family Lamiaceae, comprises one of the most culturally and medicinally valued groups of aromatic plants distributed across tropical and subtropical regions of the world (Azizah et al., 2023). Members of this genus are commonly referred to as “Tulsi” in India, where they hold deep ethnobotanical, religious, and therapeutic significance. Historically, Tulsi has played an integral role in Ayurveda and traditional healing systems, being widely used for treating respiratory ailments, fevers, gastrointestinal disturbances, infections, and inflammatory conditions (Cohen, 2014). These diverse applications are primarily attributed to the rich phytochemical profile of *Ocimum* species, particularly their essential oils, phenolics, terpenoids, and flavonoids, which exhibit broad-spectrum pharmacological activities (Dharsono et al., 2022). Taxonomically, *Ocimum* is a complex and highly variable genus characterized by extensive morphological polymorphism, hybridization, and chemotypic diversity. Out of 327 scientific plant names recorded at the species rank, only 66 are currently accepted as distinct species, while the remainder are considered synonyms or remain taxonomically unassessed (Anonymous, 2014). This taxonomic ambiguity highlights the need for continuous revision and molecular characterization to clarify species boundaries and evolutionary relationships within the genus. India represents an important centre of diversity for *Ocimum*, with nine species reported, including three exotic members, primarily concentrated in tropical and peninsular regions of the country (Anonymous, 1966). Given the ecological, cultural, and therapeutic importance of Tulsi, a comprehensive synthesis of its taxonomic diversity and biological significance is essential. Present review examines the major *Ocimum* species found in India, highlighting their native distribution, traditional uses, pharmacological relevance, and the need for conservation and further bioprospecting efforts.

Methodology

Present study is based on a comprehensive literature survey conducted during 2024 to document the diversity, distribution, ethnomedicinal relevance, and pharmacological significance of *Ocimum* species in India. Relevant scientific information was retrieved from peer-reviewed journals, books, monographs, herbarium records, and authoritative online botanical databases. Major databases consulted included Web of Science, Scopus, PubMed, JSTOR, Google Scholar, Kew’s Plants of the World Online (POWO), The Plant List, and NCBI (Kumar, 2025).

Results and discussion

The literature survey revealed substantial diversity within the genus *Ocimum* in India, with nine species reported, including three exotics primarily distributed across tropical and peninsular regions. Analysis of floristic, ethnobotanical, and pharmacological studies showed that commonly occurring species such as *O. tenuiflorum*, *O. basilicum*, *O. gratissimum*, *O. kilimandscharicum*, *O. americanum*, *O. filamentosum*, and the hybrid *O.* × *africanum* exhibit notable variation in morphology, ecological distribution, and phytochemical composition. The compiled data also documented significant medicinal applications, with different plant parts mainly leaves or whole plants traditionally used to treat ailments such as bronchitis, fever, malaria, gastrointestinal infections, diarrhoea, kidney disorders, and

respiratory issues (Table 1; Table 2; Figure 1). Updated taxonomic databases indicated that out of 327 scientific names at species rank, only 66 are currently accepted, highlighting the complexity within the genus. Together, these findings provide an integrated overview of Tulsi diversity, native origins, and culturally entrenched therapeutic uses in India. The results demonstrated that India represents an important centre of diversity for *Ocimum*, supported by both native species and naturalized exotics that have become integral to traditional medicine systems. The variation in essential oil profiles and bioactive compounds across species underscores their pharmacological potential and justifies their long-standing therapeutic use in indigenous healthcare practices. However, the high number of synonymous or unassessed scientific names within the genus reflects ongoing taxonomic challenges, emphasizing the need for molecular and chemotaxonomic studies to clarify species boundaries. The widespread medicinal use of these plants, coupled with increasing industrial and pharmaceutical demand, highlights both opportunities for bioprospecting and concerns regarding sustainable harvesting. Strengthening germplasm conservation, standardized cultivation, and rigorous phytochemical characterization will be essential to preserve *Ocimum* diversity and support future research and therapeutic applications.

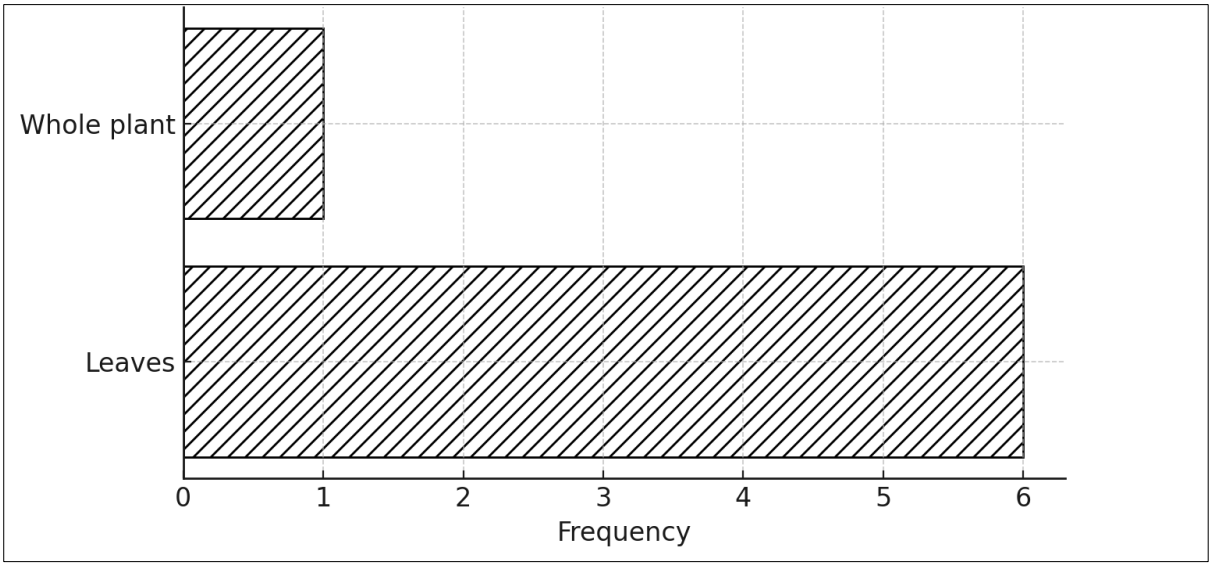

Figure 1: Frequency of plant parts used in *Ocimum* species

Table 1: Common *Ocimum* species of India and their native distribution

Botanical name	Common Name	Native distribution
Ocimum americanum L.	Hoary Basil	Tropical and Subtropical Old World.
Ocimum basilicum L.	Sweet Basil	Tropical and Subtropical Asia to Northern Australia.
Ocimum filamentosum Forssk.	Long-Stamen Basil	Ethiopia to Southern Africa; Arabian Peninsula; India; Sri Lanka; Myanmar.
Ocimum gratissimum L.	Vana Tulsi	Tropical and Subtropical Old World.

Ocimum kilimandscharicum Gürke	Camphor Basil	Ethiopia to Eastern Tropical Africa.
Ocimum tenuiflorum L.	Krishna & Rama Tulsi	Tropical and Subtropical Asia to Western Pacific.
Ocimum × *africanum* Lour.	Lemon basil	Tropical and Subtropical Old World. The hybrid formula is *O. americanum* × *O. basilicum.*

Table 2: Common *Ocimum* species of India and their medicinal uses

Botanical name	Parts used	Medicinal uses
O. africanum Lour.	Leaves	Leaves are used to treat cough (Yadav et al., 2025)
O. americanum L.	Leaves	Decoction or infusion is used to control fever (Oyedemi et al., 2017)
O. basilicum L.	Leaves	Decoction of leaves is used to treat Malaria. (Azizah et al., 2023)
O. filamentosum Forssk.	Leaves	Antiurolithic effects (Porchezhiyan et al., 2023)
O. gratissimum L.	Leaves	Leaves infusion is used in gastrointestinal infections (Nweze and Eze, 2009)
O. kilimandscharicum Gürke	Whole plant	Decoction is used to treat diarrhoea (Sarin et al., 2013)
O. tenuiflorum L.	Leaves	It is used to treat bronchitis. (Pattanayak et al., 2010)

Future recommendations

Future research on *Ocimum* species should prioritize comprehensive molecular characterization using integrative approaches such as DNA barcoding, phylogenomics, and metabolomics to resolve taxonomic ambiguities and clarify species boundaries. Expanded chemo-profiling across different ecological zones is essential to understand environment-driven phytochemical variation and identify high-value chemotypes for medicinal and industrial applications. Long-term ecological and conservation studies should be undertaken to assess the impact of habitat loss, overharvesting, and climate change on native *Ocimum* populations, with emphasis on developing community-based cultivation and germplasm conservation strategies. Additionally, more rigorous pharmacological and clinical

investigations are needed to validate traditional therapeutic claims and explore novel bioactive compounds. Strengthening national databases, standardizing identification protocols, and fostering interdisciplinary collaborations will be crucial to ensuring sustainable utilization, conservation, and bioprospecting of India's rich *Ocimum* diversity.

Conclusion

The present review highlights the rich diversity and multidimensional significance of *Ocimum* species (Tulsi) in India, underscoring the country's role as an important reservoir of both native and naturalized taxa. The synthesis of taxonomic, ethnobotanical, and pharmacological evidence demonstrates that these species possess remarkable variability in morphology, ecological distribution, and bioactive constituents, supporting their widespread use in traditional and modern healthcare. Their documented therapeutic roles ranging from respiratory and gastrointestinal treatments to antimicrobial and metabolic benefits validate the longstanding cultural and medicinal importance of Tulsi. However, taxonomic ambiguity, habitat pressures, and limited molecular data emphasize the need for strengthened conservation strategies and comprehensive chemotaxonomic and genomic studies. Advancing research in these areas will be essential for safeguarding *Ocimum* diversity, supporting sustainable use, and unlocking further bioprospecting potential for future herbal and pharmaceutical applications.

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